

Supporting Information

Hierarchical porous carbonized lotus seedpods for highly efficient solar steam generation

Jing Fang[‡], Jie Liu[‡], Jiajun Gu^{*}, Qinglei Liu^{*}, Wang Zhang, Huilan Su,
and Di Zhang

State Key Laboratory of Metal Matrix Composites, School of Materials
Science and Engineering, Shanghai Jiao Tong University, Shanghai
200240, China

*Correspondence and requests for materials should be addressed to J.J.
Gu (gujiajun@sjtu.edu.cn) and Q.L. Liu(liuqinglei@sjtu.edu.cn)

Experimental Section

Materials Preparation: Fresh lotus seedpods used in experiments were bought from vegetable market. After freeze drying for 48 h, fresh lotus seedpods were treated at 500 °C in N₂. The heating rate and soaking time was respectively 5 °C/min and 12 h. Then the carbonized lotus seedpods were immersed into water for 12 h and then washed with water and ethyl alcohol for several times. Finally, clean carbonized lotus seedpods were obtained after drying at 60 °C for 24 h.

Characterization. The microscopic morphology of carbonized lotus seedpods was collected by a field emission scanning electronic microscope (FESEM, Hitachi S-4800). The pore structures of samples were characterized by N₂ adsorption–desorption at 77.4 K (Micromeritics ASAP 2020). X-ray photoelectron spectroscopy (XPS, Kratos Axis Ultra DLD) analysis was conducted using Al K α radiation (1486.6 eV). UV-vis adsorption spectra was recorded by a UV/VIS/NIR spectrometer (PerkinElmer, Lambda 750S). An IR camera (FLIR T620) was employed to measure the temperature changes. Water contact angles test were measured using a contact angle measuring device (JC2000, Shanghai zhongchen, China). Transmission electron microscopy (TEM) characterization of the carbonized seedpod was carried out using a JEM-2100F.

Thermal conductivity measurement. The thermal conductivity of fresh lotus seedpod, carbonized lotus seedpod and wet carbonized lotus seedpod was measured and calculated by equation $k = \rho \times \alpha \times c$, where ρ is the density, which was calculated from the weight and volume; α is the thermal diffusivity, which was

measured by a Netzsch LFA 447 Nanoflash, and c is the specific heat capacity, which was measured by differential scanning calorimetry (DSC, Perkin Elmer DSC8000). The sample size is $1\text{ cm} \times 1\text{ cm}$, thickness $t < 1\text{ mm}$.

Solar vapor generation. Carbonized lotus seedpods were placed in a beaker (50 mL, $\sim 42.0\text{ mm}$ diameter) with 40 mL distilled water inside and then irradiated by a solar simulator (Newport 94023A, Class AAA) at room temperature ($25\text{ }^{\circ}\text{C}$). The mass changes were monitored by an electronic analytical scale (BSM-220.4), real-time recorded by a computer. The measured evaporation rate of samples under the dark field was subtracted from the one under irradiation.

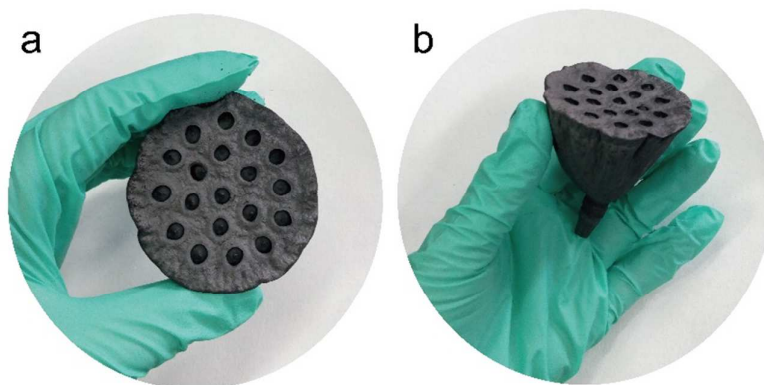


Figure S1. Digital images of (a) top view and (b) side view of a carbonized lotus seedpod.

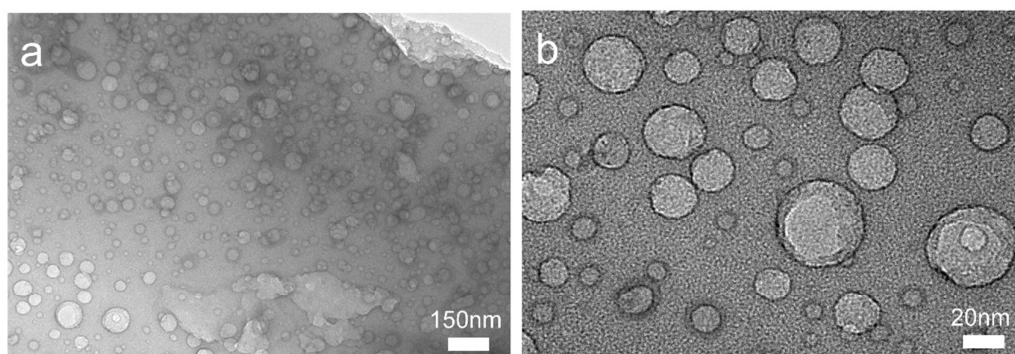


Figure S2. TEM images of a carbonized lotus seedpod showing the existence of mesopores and macropores.

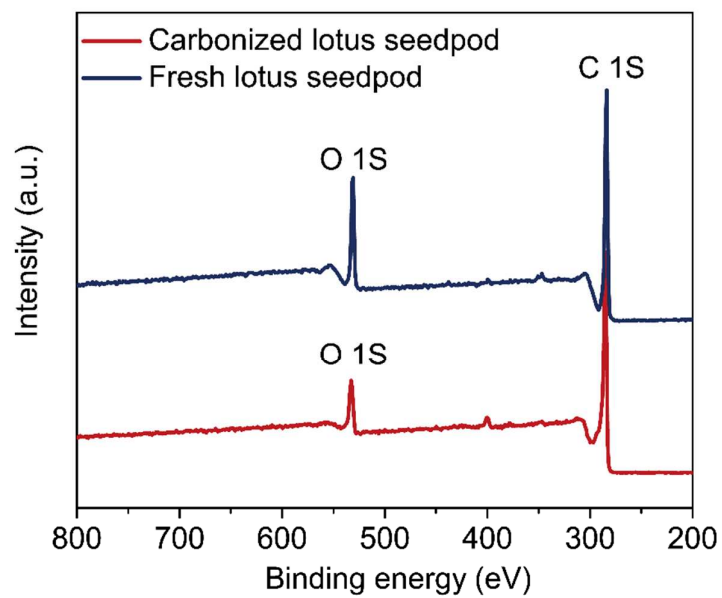


Figure S3. XPS spectra of carbonized lotus seedpods and fresh lotus seedpods, respectively.

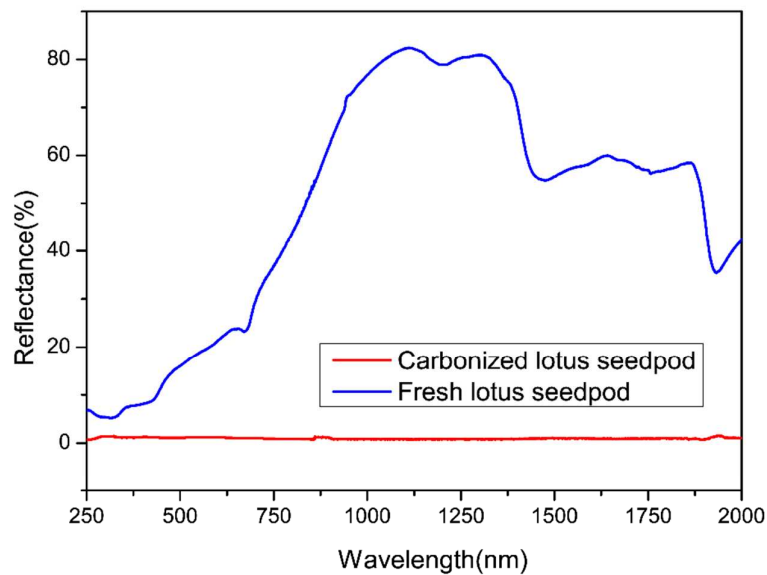


Figure S4. UV-vis reflectance spectra of carbonized lotus seedpods and fresh lotus seedpods, respectively.

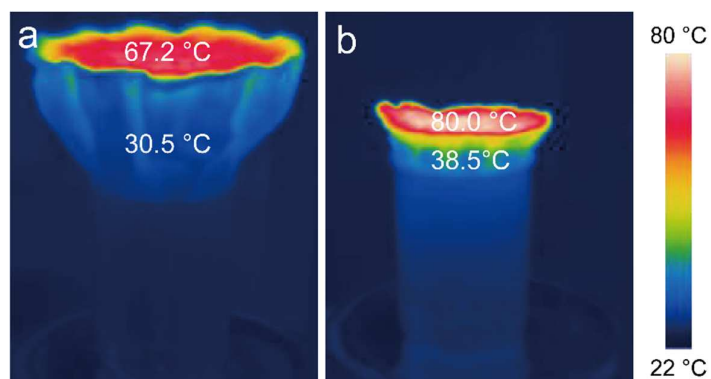


Figure S5. Infrared photos of (a) a fresh lotus seedpod and (b) a carbonized lotus seedpod after 1 sun light irradiation for 600 s.

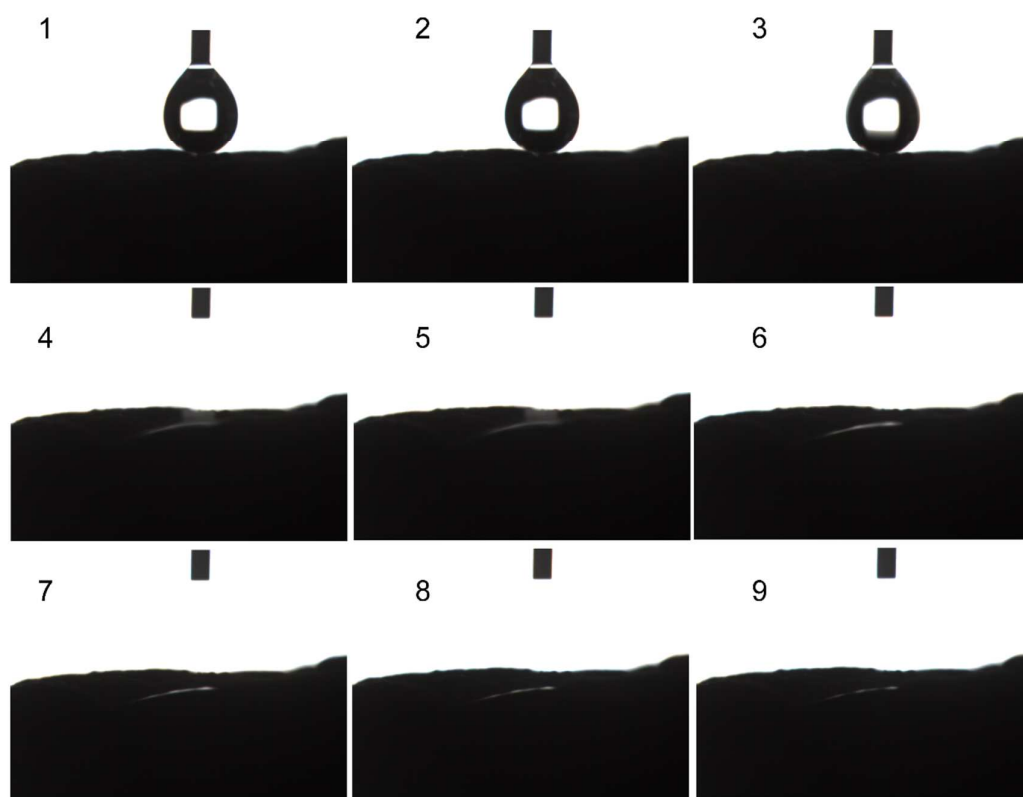


Figure S6. Water contact angle test of the surface of carbonized lotus seedpod. The time interval for each image is 53 ms.

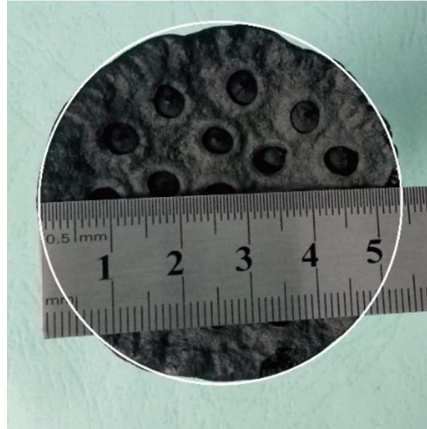


Figure S7. Digital image of the carbonized lotus seedpod. The white circle indicates the maximum outer contour of the lotus receptacle.

Table S1. Thermal conductivity parameters of fresh lotus seedpod, carbonized lotus seedpod and wet carbon lotus seedpod.

	Density ρ (g/cm ³)	Thermal diffusivity α (mm ² /s)	Specific heat capacity c (J/(g·K))	Thermal conductivity k (W/m·K)
Fresh lotus seedpod	0.225	0.637	1.464	0.210
Carbonized lotus seedpod	0.179	0.598	0.735	0.079
Wet carbonized lotus seedpod	0.679	0.149	3.571	0.361